

Hot Iron

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Contents

CW in Oman

Amplitude Modulation

John Teague info

Paul Tuton's views

Andy Howgate tests

Air coils for Dipper

Brendon Buildathon!

Capacitor Selection

& further comments

Low cost Meters

Cleaning relays

E news-sheet?

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Editorial

Many of the notes in this Hot Iron are connected with Amplitude Modulation in one form or another; this is because I am always keen to explore ideas for rigs that put a slightly different complexion on the standard rig concepts - after a while one needs to deviate from yet another standard direct conversion rig! Why AM then? Somewhat to my surprise a couple of Construction Club Members have expressed a keen interest in the topic and it happens to coincide with another 'historic' development! A good friend of mine has a site that was used by the Auxiliary Services during World War 2 and it appears that a 17 set was the normal equipment fit. This had just two valves which provided a regen TRF receiver and an AM phone transmitter with a nominal output of about 1/3 Watt; the frequency coverage being about 45 to 65 MHz. My friend would like to put the site back on air for a special event which made me think about a modern version of the 17 set. I would not wish to do it with just two transistors as I feel certain that the RX and TX frequencies (both derived from the regen stage) might be several KHz apart and very prone to frequency pulling as the aerial moves in the wind! The operators of the original 17 set must have been pretty good to undertake two way messages! But it has made me think about AM as another approach for relatively simple phone operation. See later and watch out for the Churnside rig - this was the name of the wartime net in my friend's area!

Tim G3PCJ

Kit Developments

Just to prove that I am making progress with the **Minster**, the photo on the right is the partly built prototype fitted with a front panel that has the controls for several of the optional extras. The rig is now working well on 40m after several niggles have been cured. The main problem has been that I gave it too much gain in the TX strip requiring some re-balancing between stages in both the receiver and transmitter. Some decoupling electrolytics were not large enough - needing many minor track alterations. I also changed the output stage to a broadband transformer and conventional LPFs - much simpler! The next task is to add the RF extras for two more bands to 10m! Tim



Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics— is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

CW in Oman by David Buddery G3SEP

I had a great ham radio year in Oman from mid '85 to mid '86 when I had to come back to the UK. It took me 6 months to get my license and another month to get my gear out there. I built a 30 foot wooden antenna mast whilst I waited and got the antennas up, so once the gear arrived, it was "plug in and go". I put up a 14 MHz quad loop hung from the mast erected on the villa flat roof. It could see the sea and the path to Europe, the USA, South America etc. which worked fine on 14 and 21 and better than it should on 28Mhz. For 3.5 and 7 MHz I put up 66 feet of sloping wire at about 45 degrees to the vertical and fed it at the base against a couple of 66 feet length insulated radials which ran around the garden of the villa, tucked in at the base of walls. Both of these aerials were fed with BOFA slotted 300 ohm twin, what magic stuff it is.

My old trusty KW2000A worked a load of stuff barefoot from there. I had a separate Drake R4C receiver and I had modified the 2000A to give me a separate receiver antenna output for the R4C. It was close to the bottom of the sunspot cycle, but the sub-tropical location of Oman improves propagation and I was surprised how often 28 MHz was open to Europe. I could not believe how quiet it was out there – very little noise on 3.5 and 7 MHz. I spent most of my time on the air on CW but did use SSB a bit often on request. Most days I would get 1 to 2 hours on air from about 1630 to 1800 or 1830 then maybe a bit more time later on. I always looked first at 21 MHz. If it was lively with good signals to Europe, I make maybe a 100 QSOs (usually all on CW, quick as I could!), let the band know I was about to QSY up to 28 MHz and maybe 8 times out of 10, 28 MHz would magically open, often to Europe and even to the UK. People would say I was the only signal on there, which goes to show!

There was often the most amazing grey line propagation from Oman. Ahead of the CQ WW CW contest in 1985, I looked at the grey line for the date and figured that it would be worth looking on 7 MHz at around dusk for stations in the central Pacific. Lo and Behold, this KH6 appeared at well over S9 with a few others and I worked them. It was just before dawn there and normally no-one would be on the air at that time, but of course, it was a contest weekend. There were other strange openings like this. It was dusk one day and 28 MHz was going out. I was just looking round to see if there was anyone left when I heard a call and it was a CE3 from Santiago in Chile. I worked him, only to be called in succession by 4 of his pals! I sent all 5 QSLs the next day to one of them who promised to pass them round.

Much to my annoyance I had to go back to the UK in mid '86 when the oil price crash occurred (the first one). I wrote the radio club a letter thanking them for helping me to get the license, which I enclosed for cancellation. Apparently I was about the only person who ever did this in their history and it went down very well. I went back out to Oman on a visit in '87 and the evening of the day I arrived, I went back to the Radio Club where I was welcomed with open arms. I was more than welcome because I had a big Toyota Land Cruiser and they were putting up a special event station in an open area and designed around a traditional Omani "Barusti" (reed and thatch, split palm tree trunks) house. My Land Cruiser and its roof rack were that very evening pressed into use carrying gear, masts etc down to the site. It was a bit like NFD. I knew I would enjoy it and thought a bit wistfully it was going to be sad for me not being able to operate because I no longer had a license.

But then something happened. Salim the Chairman came up to me and said "Dave, can you operate this weekend please?" I of course had to remind him gently that I no longer had a license. He replied, "No problem, can you be here at 8 pm tomorrow night? The Minister will be here and I'm going to get him to give you verbal approval to operate this weekend, but please, can you do an all-night session and work us lots of DX.?" The word HAD got around and they hadn't forgotten! Of course I agreed right away and was on tenterhooks all the next day hoping and praying this was going to work out. But the next evening I got this approval from the Minister who was charming. He turned up again on the day of the event when I was in a truly massive pile-up banging out CW at 35 WPM ++. He just stared at me and said, "You know, I always wanted to learn how to use one of those bug keys!" I remember sitting there in the early hours of the next morning, on the air, alone apart from a security guard, thinking "NFD at the Great Yarmouth Radio Club

trained me well for this sort of thing." I'm sure it was the fact that the club there recognised me as a CW operator that swung it for me!



Amplitude Modulation continued from HI 58.....

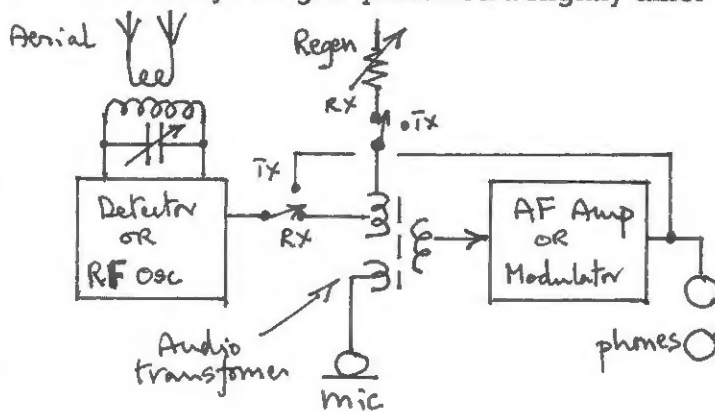
Following my remarks on this mode of operation last time, a couple of members expressed a strong interest in the subject; John Teague G3GTJ sent me the following helpful information about nets etc.. I quote verbatim....

"I was interested in your page in Hot Iron about AM - "Ancient Modulation" to the aficionados like me. I like the idea of using the Kilton. Concerning nets - there are AM activities on most bands, I believe, if you know where to look. At HF these are mainly US driven. In UK the most popular AM band is 80m, in particular on 3615 MHz. On Saturday mornings from 0830 - 0930 VMARS (Vintage & Military Amateur Radio Society) run a net which usually has a dozen participants and has had as many as 20. People who are retired like me use this frequency a lot during the week too, around 1230 and often in the afternoons from 1430 or thereabouts. All users of AM are welcome on these occasions whatever equipment they use. One or two enthusiasts monitor the channel and respond immediately to a CQ AM call. Tony G8AQN is one and Mervyn GW8TBG another. Another net on Saturday mornings from 1030 operates on 3625. Led by Gerald, G3LEO, this net is much smaller with three or four regular takers mainly in the north of England with plenty of technical talk.

The equipment used can be modern, old, or ex-military. The Codar AT5, designed for the amateur market in the fifties is popular and gives remarkable results for 5 watt output. For QRO oomph the Heathkit DX100 of the same period is a good choice. The Rolls Royce of AM transmitters is the Labgear LG300 of the late fifties, beautifully engineered with an 813 in the final. These radios are all "hollow state" and can be bought at rallies but prices of good quality vintage and military gear are rising fast. There are plenty of cheaper restoration projects: replacement valves are not usually problem although a few can be difficult including the 7360 beam deflection tubes. VMARS has an extensive archive of technical data.

There is a plethora of second world war items available and Racal produced a series of QRP manpacks in the 1965 - 1975 era which was the transition period between AM and SSB for the military. All these radios generate DSB+carrier AM as an option to SSB by contrast with amateur transceivers which almost universally opted for A3E - single sideband full carrier."

John's letter and my friends desire to have, or resurrect, a 17 set for his Auxiliary Services site set me thinking about a modern version of the 17 set and other 'Paraset' type ideas that are of interest to many. The 17 set is very economical in its 'active devices' with just two valves! These were 2 volt heater types using an HT of 120 volts. One is a regenerative detector whose tuned circuit is directly coupled to the balanced aerial by a link winding. The regen control is in the anode supply to the detector's audio transformer which feeds the second valve as a conventional audio amplifier for the phones. On transmit, a carbon mic feeds the same audio transformer driving the second valve as a modulator of the RF valve which now has full supply, to ensure oscillation with about 1/3 Watt RF carrier output! See the block diagram below. All done at 50 MHz with no obvious precautions to ensure frequency stability, or the same RX and TX frequencies! The wider bandwidth, & tuning insensitivity, of AM is essential for such techniques. A modern version would need good stability and avoid radiation during reception. In Hot Iron 58, I suggested a method by which a Kilton could be amplitude modulated - it works well but Andy Howgate preferred a slightly different approach - see the next page. AM can be done easily at low level but for use at 50 MHz I think crystal mixing from a low frequency VFO will be essential and the challenge is to make this suitable for many bands. For reception I think that a regen TRF is adequate and in keeping with the theme. (A Knapp fitted with a suitable toroid as in HI 58 photo could be pressed into service on any HF or low VHF band easily.) I am uncertain whether the complications of providing CW as well are sensible - any views on whether this is best left to a dedicated CW set for most of the normal HF bands? G3PCJ



SIMPLIFIED BLOCK DIAGRAM OF 17 SET
G3PCJ

More AM topics!

Paul Tuton writes ... "Today, if you want to build a 10watt, solid state, AM transmitter, then (a) is there an easy 'plate & screen' modulation equivalent or (b) is the low power AM driver/linear a better approach? I first started tinkering with AM about 40 years ago. With valve transmitters of around 10w, it was extremely easy to choke modulate the final via a standard speaker output transformer driven by a basic audio amplifier. With a bit of care, the quality and depth of modulation could be very good.

Moving up to higher RF powers demanded corresponding increases in modulator output and a transformer of the Woden UM type, which I didn't have and couldn't afford. I wanted more RF but without the cost penalty of a powerful audio amplifier, the associated PSU and a hefty modulation transformer. The answer seemed easy. Forget about anode modulation and use e.g. grid modulation as found in some of the cheaper commercial AM transmitters of the time. Of the various alternatives that I tried, most of them worked, to a degree. I discovered that controlled-carrier modulation could be quite effective, though it was tricky to set up and often sounded odd at the receiving end. I even tried NBFM, long before the mode was commonly available on receivers. With slope detection and a half decent RX, it seemed the most promising of all. But nothing that I tried could compete with plate (& screen) or even choke mod.

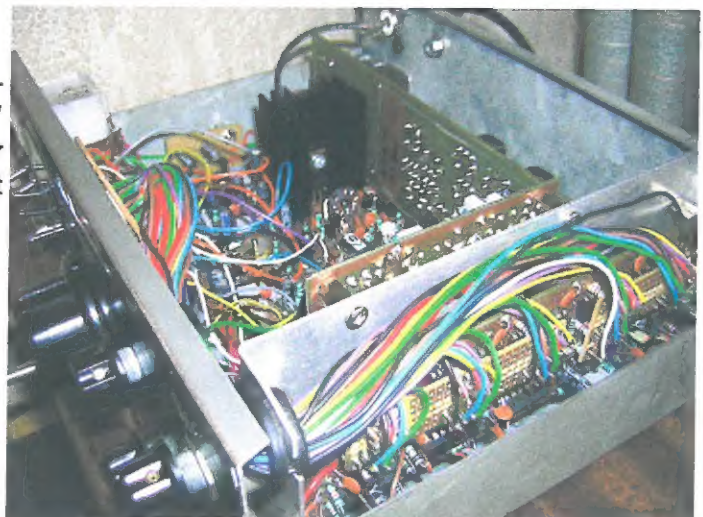
Even today, many AM signals are poorly modulated (listen on 80m around 3600 to 3630). S7 carrier levels with barely-discernable audio are fairly common. There are not many fully modulated, punchy signals. When you do hear them, they really stand out. (Almost) invariably, they are using muscular modulators of the plate & screen variety. I've occasionally heard perfectly readable AM signals as low as S3.

A few years back, I picked up a 1979 PW containing a construction article for an AM top band TX. About 8 watts output from a VMOS PA and high level modulation applied via an audio choke - again, a speaker transformer but this time, using the secondary (speaker) winding. The only awkward part was that it required a 15ohm tap. I copied the concept and built an AM 160 / 80 transmitter based on Tim's Dundon kit, but with an IRF510 PA. (A little later, I described it briefly, in Hot Iron). I didn't have a suitable speaker transformer, but soon discovered that Maplin stock an audio Line Transformer that does the job. For the modulator, I used a standard 5 watt module and preamp. The results have been very good, with Q5 reports at S5 signal strength and with an upward kick on mod peaks. With an 18Volt supply, the TX output is around 8watts.

While ambitions remain around the 10watt level, my experience is that good modulation can be achieved easily with a simple choke/transformer. If you have to buy one, Maplin's line transformer will cost you around £14, though I expect there are plenty of alternatives that will work just as well. But the question remains; will a driver/linear produce results that are as good or better? Most that I have heard - mainly on top band at the 5 watt level - have not been impressive. However, I can think of one in particular that is good, so it can be done. Being conditioned by early experience, I have yet to try, so I'm hoping that one day, Tim will come up with something.

Amongst the very best of AM signals that I have ever heard was on 80 meters several years ago. It was astoundingly good, and came (as I recall) from a modified FT101 - a low power AM driver followed by linear. It belonged to Peter Chadwick G3RZP and clearly, he knows what he's doing. Maybe that's the secret.

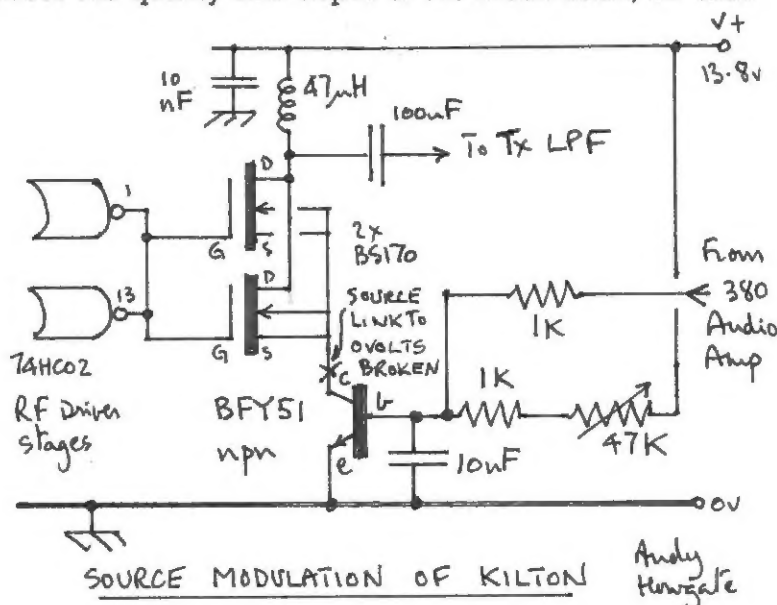
Nothing to do with AM - but this is Simon Burgess' very smart Bristol!



Yet more on AM!

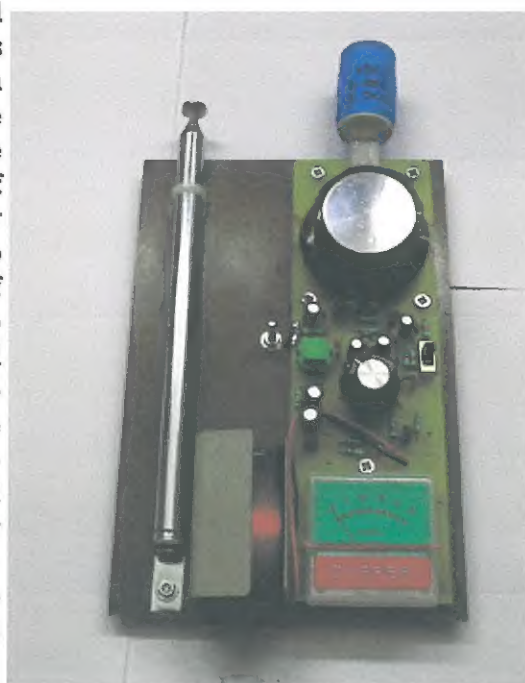
Andy Howgate has reported on his experiments with a Kilton 1.5W CW transmitter modulated by a LM380-8 as part of a standard Audio Amplifier kit. The latter has a twin BS170 low level stage that feeds an AFG type preset that then feeds the 380 output stage. Because the DC output of the 380 chip is at half supply voltage with the wanted audio superimposed on it, and potential output current of fractions of an Amp, the chip can be used directly to power the output stage of a low power CW transmitter like the Kilton. (See the last HI 58.) If used this way, the AFG preset then becomes a mic gain or modulation level control. When I tried this combination I found that it worked very well with excellent modulation waveforms. The carrier power was just over a third of a Watt peaking up to four times that as expected. (I have since found several very similar approaches expounded in SPRAT and PW over the years - one just last Autumn!)

However Andy experienced some problems with the common tendency of the 380 amplifier to oscillate at around 2 MHz!! It then draws much current and gets very hot! (I don't think this method of oscillation can be used as the source of the desired RF!!) After curing this tendency of unwanted oscillation, he was still uneasy about the quality and depth of the modulation; he then tried source modulation by separating the sources of both BS170 RF output transistors from 0 volts. Keeping them (RF output) supplied with 13.8 volts he used a BFY51 between BS170 and 0 volts acting as the modulator. See circuit right. With no audio signal the 47K preset from the supply is adjusted to provide a quarter of max RF output, and then the audio drive from the 380 is adjusted to achieve full modulation. He found this worked rather better than my original suggestion. Some readjustments of the carrier power level and audio drive may achieve a slightly more punchy signal. He was actually using the Kilton to drive a 10 Watt Linear amplifier but I don't see why that should make either modulation method better than the other.



Dipper Coils by Andy Howgate

I hit on a super easy idea for making good air cored coils. Fluorescent starters is the thing - remove the innards and you have a super plastic former. Drill two 1 mm holes in the end that line up with the pins of the connector you are using. Then super-glue the connector body to the end of the starter. The next bit is winding the coil; two further holes of 1mm are drilled in the end alongside the pins, and another one on the outer body of the tube where the winding is to start. Feed the copper wire through this hole and then one of the holes by the connector pins - use long nosed pliers to reach inside! The wire is cleaned, tinned, wrapped around the connector pin and quickly soldered to prevent the connection moulding melting! Now wind your coil onto the outer of the starter tube; at the end of the winding drill another 1 mm hole through the starter body to bring this end inside the tube; then thread it through the other hole already drilled next to the other connector pin. Clean off the insulation, wrap and quickly solder to the pin. That is it! Superglue top and bottom to secure the coil. When dry, apply heat shrink sleeving or insulation tape, & mark frequency range.



Brendon Buildathon! by Brian Jones, G1ZEZ

I recently attended the Bath Buildathon where a group of amateurs got together for a day to build a transceiver each. The design chosen was Tim Walford's Brendon and so I volunteered to write a few words about the day for Hot Iron. First a little about my background in amateur radio. I took the RAE and got my licence while at sixth form college in the late 80s. Being a student meant that I couldn't afford fancy transceivers and so I started out by converting a low band FM Pye Westminster to run on 70MHz. I tinkered and tweaked but didn't build any complete projects other than a few aerials from scrap metal (the 1987 storm provided a rich source). I dabbled in amateur radio while at university but aerials were always difficult when staying in digs and so I became less and less involved in the hobby.

A new burst of enthusiasm came when I heard the news that HF would be available to Class B holders. It took me a while to get organised but eventually I renewed my licence and rejoined the RSGB. In one of the first RadCom issues I received as part of my new membership I saw the news item announcing the Bath Buildathon which had the aim of getting a group of new constructors together and building a complete sideband transceiver in just one day. This sounded like the perfect project to get me back into the hobby and so I contacted the organiser, Steve Hartley G0FUW, and luckily got the last available place. Having paid the £60 fee it was not necessary to turn up with anything beyond a packed lunch - the Brendon transceiver kits, tools and test equipment were all provided.

After brief introductions and some tips on soldering we set to work. There were 12 constructors working 4 to a table but remarkably little chatter: everyone had their heads down checking component locations, soldering (sometimes re-checking component locations and de-soldering...) Tim's staged construction process was rigidly enforced with instructions for each step only being provided once the tests for the previous step had been passed. It was remarkable how many of the electrical tests were passed first time for many of the people present - a good sign of a robust and well debugged design.

After lunch Tim turned up with a completed Brendon Transceiver and set up a small station. Shortly afterwards some of our receiver stages were completed and we were able to pick up our first signals. An hour or two later we also had some completed transmitters and could make our first (very non-DX) contacts. I suppose many people reading this will know exactly how it feels to build a transceiver and make that first contact, and now thanks to the Buildathon there are a few more people who have found that thrill.

I had thought about getting a transceiver kit several times in the past and while I was confident that I could get one to work I always worried that I would hit some hurdle such as a hard-to-find bad joint or misaligned circuit element that would frustrate me and leave me with just an unfinished project. But, working with a group of others gave an extra feeling of confidence that everything would be working by the end of the day and seeing that happen has really fired me up to get into more construction.

Since getting home with my completed transceiver I have ordered a few more kits from Tim and now have a working dipper oscillator and frequency counter as well as an aerial matching unit that will be getting built when I next have a free evening. My next steps are to plan out the best way to get an 80m aerial system up without annoying the neighbours and then work out how to stealthily drill the holes for the aerial/earth feeds in what was our spare bedroom but is now my new shack.

Slightly perversely, having waited until Class Bs could operate on HF I now have an urge to learn Morse code - I very much like the simplicity of CW transmitters and quite fancy a crack at building one with some ugly/dead bug construction. So the combination of a nicely thought out kit and a well organised event definitely fired my enthusiasm and I am sure that I was not the only one. Many thanks to Tim and Steve.



Capacitor Selection by Gerald Stancey G3MCK

In the old days there were very few types of capacitor in common use (paper, silver mica, electrolytic and disc ceramic) so deciding which type to use in a particular circuit was pretty easy. Now there is a plethora of types, many beginning with poly from which to choose and the correct decision is often by no means clear. The professional designer has detailed knowledge of the characteristics of each type and having made the best technical choice then gets the purchasing department to buy what he wants. The amateur is often uncertain what can be used and even if he does know he may have a problem getting them. This article approaches capacitor selection from the point of view of the home constructor who wants to know if something that he has in his junk box can be used.

The most critical application area for capacitors is in RF tuned circuits and filters. In these applications silver mica, polystyrene, COG type (also known as NPO) ceramics and negative temperature coefficient ceramics are the types most commonly used. A word of caution, be sure when using ceramics that they are suitable for RF tuned circuits; I have had a bad experience in this area.

In RF decoupling, the ceramic now seems to be the material of choice. However other types maybe used such as paper, silver mica and many of the poly types.

For AF decoupling, practically any type of capacitor can be used and the same goes for smoothing capacitors in power supplies but the high values of capacity that are needed usually drive you to using electrolytic capacitors.

It is always possible to use a higher quality than is necessary, for example using a 1000 pF silver mica in an AF circuit. This may appear to be unwise considering the cost of silver mica capacitors but if you need one of a certain value to finish the job, and that is all there is in the junk box then use it. A professional friend tells me that at his company, when making one-offs, they are encouraged to use anything from redundant stock provided that it meets the technical requirements.

When choosing a capacitor there are other considerations such as size and working voltage and these must be met before thinking about the type of capacitor that should be used.

Some additional comments!

Identifying the type of an unknown capacitor is very difficult but some clues maybe deduced from its shape. First the easy ones; silver mica are usually very thin and rectangular while polystyrene are usually cylindrical with either clear plastic for the common low voltage types, or a metal casing for the higher voltage specimens - for all of these types the tolerances are quite small - often $\pm 2.5\%$ and they are expensive - typically 75 - 100p each when new. Silver mica tend to have a nominal zero tempco but with quite a wide tolerance of the actual tempco; polystyrene generally have a N150 tempco. I must admit to not liking either of these types in oscillator tuned circuits as I find they lead to wandering up and down in the VFO frequency. Ceramic capacitors come in many shapes and are usually much cheaper and more suitable for VFO resonators; the modern ceramic plate types are usually small light green rectangles about the size of a match-head, their tolerances are often $\pm 2\%$ and for 22 pF to 150 pF have a N150 tempco - meaning their capacitance goes down by 150 parts per million for each degree C rise in temperature. Hence their main use is in VFO resonators to counter the positive tempco of the resonator inductor. Their use is not necessary, nor the extra cost justified, for other inter-stage tuned or filter circuits. Close tolerance round ceramic discs are also available with the NPO (= COG) characteristic meaning nominal zero tempco which is indicated by a black tip or flash. Less common now but still available are round N150 ceramic discs, these have an orange tip or flash. Larger value ceramic caps can also have a X7R or Z5U characteristic which is definitely not suitable for VFOs, nor for tuned circuits owing to very much higher tolerances ($\pm 20\%$) & tempco (they are said to be medium K or high K), but they are cheap and often used for RF coupling/decoupling purposes where exact capacity is not important. For HF decoupling purposes it is common to find a 10 nF medium K disc in parallel with a 10 uF electrolytic; similar approaches are used for much higher frequencies. No form of ceramic capacitor should be used in audio stages as they are micro-phonic - use polyester ones which are rectangular blocks - sometimes moulded, or dipped, or with exposed metallic connections down their sides. Disc ceramics are also available with higher working voltages up to about 5 kV but their Q is poor and they are not suitable for filter resonators where a high Q is desired.

I am afraid Gerald has touched on a veritable minefield!! Tim G3PCJ

Moving coil meters

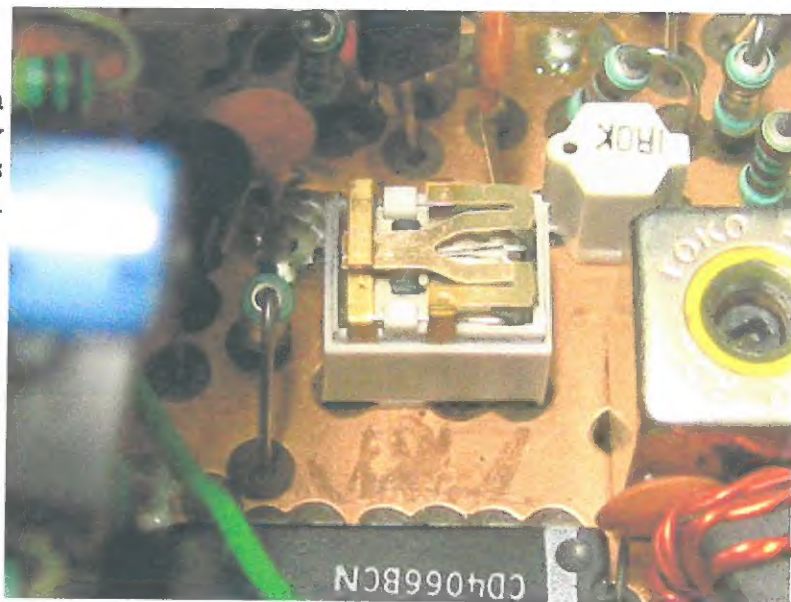
I still have some excellent brand new 50 uAmp meters with rectangular 2.25 x 2.75 inch faces. Because I got these cheap I can offer them at three for £10 plus £3 P and P. G3PCJ

Cleaning relay contacts

Paul Tuton writes ...

Tim, here's a picture of the relay, Taunton RL102, in situ, lid off. Easily removed by careful winking with a watchmaker's screwdriver & gently pulling/twisting with medium-nosed pliers.

Was fine on RX, but dodgy contact on TX. Switch to TX activates the relay and snaps the common connection to the upper contact. Inserted a piece of thin card, switched to TX and scrubbed lightly, to & fro. Wouldn't dare risk wet & dry - much too fierce. Then repeated with a blob of electrolube on the card. Seems 100% again. Lost the lid but who cares!



By the way, years ago we used newsprint (avoiding the ink!) to clean the gold plated edge connectors of PDP-11 plug-in modules. It was amazing how much black appeared on the newsprint and how shiny the connectors became. From time to time, still do the same with PC boards. Very effective and does no damage.

Electronic news

One Construction Club member has suggested that it would be nice to have an e mail 'news' service from Walford Electronics; I am wondering what others think about the suggestion? Owing to the way I do diagrams it is not practical to distribute Hot Iron down the wire but I could certainly send out electronically a short e news-sheet with advance warnings of new kits and other matters that do not involve hand drawn diagrams. If you would like this, send me an e mail at walfor@globalnet.co.uk with your suggestions for what ought to go in it! Tim G3PCJ

The Somerset Supper ***and*** ***Yeovil QRP Convention***

The fourth supper will be held on Saturday April 26th 2008 at the Antelope Hotel, Sherborne (as last year) area for locals and those staying overnight. This is the evening before the Yeovil QRP Convention. As before there will be a small display of items from each diner's home built radio equipment! This will qualify you for a **free** place at the supper table! The display will be judged by **Steve Niewiadomski**, who contributes interesting construction articles to PW. **Places by advance booking only by April 19th so please tell me if want to come.** Hope to see it and you! The QRP Convention will have the usual programme of radio related lectures including one by Stef, trade stands, bring and buy stall, and other excitements! I shall be there and am always pleased to see and display if appropriate any of my customers 'constructions'. Tim G3PCJ